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MIYAHUNA ASSET MANAGEMENT PLAN AND PROCESS

March, 2013

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INSTITUTIONAL SUPPORT AND STRENGTHENING PROGRAM (ISSP)

MIYAHUNA ASSET MANAGEMENT PLAN FRAMEWORK

March, 2013

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ACRONYMS

AM	Asset Management
AMC	Asset Management Committee
AM/MM	Asset and Maintenance Management
AMP	Asset Management Plan
BP	Business Plan
CEO	Chief Executive Officer
CIP	Capital Improvement Plan
CM	Corrective Maintenance
CMMS	Computerized Maintenance Management System
CS	Customer Service
CUPSS	Check-up Program for Small System
DM	Deferred Maintenance
FA	Financial Affairs
FTE	Full Time Employee
GIS	Geographic Information System
HHU	Hand-held Units
HP	Horse Power
HR	Human Resources
ISSP	Institutional Support and Strengthening
IT	Information Technology
KPI	Key Performance Indicators
kWh	kilo Watt hours
LOS	Level of Service

MCM	Million Cubic Meters
NRW	Non-revenue Water
O&M	Operation and Maintenance
P&Q	Production and Quality
PdM	Predictive Maintenance
PM	Preventive Maintenance
PMU	Program Management Unit
TA	Technical Assistance
TS	Technical Services
USEPA	United States Environmental Protection Agency
UV	Ultra Violet
WAJ	Water Authority of Jordan
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

I INTRODUCTION

Managing Miyahuna's assets through the implementation of world class Asset and Maintenance Management (AM/MM) practices is a key milestone to becoming an effective low cost service provider. Minimizing the life cycle costs of the company's critical assets is fundamental and is accomplished through developing Operation and Maintenance (O&M) practices from reactive to proactive and integrating life cycle costs into repair, rehabilitate or replacement funding decision-making.

The Institutional Support and Strengthening (ISSP) Team is currently working with the Miyahuna managers in the implementation of "Best Practice" AM/MM Techniques throughout the company's work processes. The improvement is accomplished through the integration of industrial business, maintenance and fiscal accounting practices, tied to the company's everyday O&M activities.

An Asset Management Plan (AMP) is the key foundation of an effective long term AM/MM program. It is carried out through a combination of Information Technology (IT) systems and programmatic improvements to everyday practices in the utility, tied directly to condition monitoring and fiscal decision-making integration processes designed specifically to produce the minimum life cycle costs for the utility's critical fixed and rotating assets. ISSP has undertaken a "Gap Analysis" (see Appendix "A") which provides a blue-print to improve asset management business practices in both rotating assets (pumps, motors, etc.) and fixed assets (pipe network, meters, etc.), starting with the development of the AMP for Miyahuna. The Miyahuna executive management appointed an Asset Management Committee (AMC) to commence work on this essential effort in January of 2013.

This report is a preliminary document that sets out the broad principles to be developed into key processes, procedures and actions, and outlines the process that is currently being undertaken to develop the Miyahuna AMP.

2 APPROACH AND METHODOLOGY

In supporting Miyahuna's AMP development, ISSP is engaging the AMC as well as supporting the development of the process implementing the following activities:

- Information gathering through one-to-one interviews and on-the-job observation. This was carried out for the overall assessment of business practices and associated tools utilized in the various functions within Miyahuna in relation to AM/MM, and for the "Gap Analysis" that ISSP had undertaken previously.
- Engaging Miyahuna's executive management in developing the AMP through the assigned committees (AMC and working groups emanating from it). By this ISSP ensures the right level of engagement of Miyahuna staff (executive management through monthly meetings with the AMC, and functional units through the assigned working groups from the various Directorates in Miyahuna working with the ISSP team, as needed, on the requirements of developing the AMP). This also supports the objectives of building the capacity in Miyahuna to develop its AMP through engaging the staff in the development process itself, as well as creating the sense of ownership of the AMP, as it develops from Miyahuna staff supported by ISSP.
- Utilizing tools that facilitate the development of the AMP with a built-in plan outline and structure that can be easily updated by Miyahuna staff in the future. The tool is called the "Check-Up Program for Small Systems" (CUPSS)¹, developed for the United States Environmental Protection Agency (USEPA). Utilizing CUPSS software entails: (1) setting it up for Miyahuna (ISSP team setup CUPSS on a laptop that will be turned over to Miyahuna upon the completion of its AMP, with designated Miyahuna staff members trained to maintain it); (2) populating CUPSS with data and information, as required within the various modules, including inventory, O&M, capital investment, financial and business related data/information; and (3) keeping up the program tools and annually updating data inputs and information by Miyahuna.

¹ CUPSS is a free, easy-to-use, asset management tool for small drinking water and wastewater utilities. CUPSS provides a simple, comprehensive approach to develop a record of assets; a schedule of required tasks; an understanding of the financial situation of the utility; and a tailored asset management plan.

3 THE ASSET MANAGEMENT FRAMEWORK

The goal of AM in a utility is meeting a required Level of Service (LOS) in the most cost-effective way through the acquisition, operation, maintenance, rehabilitation, replacement and disposal of assets to provide for present and future customers. It aims to ensure the long-term sustainability of the services provided by the utility to its customers. It hinges on five core components:

1. The current state of the assets. This entails identifying what Miyahuna owns as assets; where they are located; what is the condition of the assets; what their remaining value is; and what useful life cycle remains for them. If some of this information is too difficult to locate, estimates will need to be used when necessary.
2. The sustainable LOS agreements, as identified in the utility's business plan. These translate into a set of features that describe Miyahuna's short-and long-term performance objectives, performance standards, regulatory requirements, customer/stakeholder expectations, as well as how improvements in efficiency and cost of service are to be accomplished.
3. Criticality ranking of the assets. Critical assets are those that Miyahuna decides have a high risk of failing (i.e. if the asset is old or in poor condition) and have major consequences if they do fail (major expense, system failure, safety concerns, etc.). Miyahuna will decide within the AM process how critical each asset is and rank them accordingly, within an asset risk matrix. It is also essential to identify the cost to repair, rehabilitate, or replace critical assets, as well as any other indirect associated costs, such as social or environmental costs.
4. Identifying the utility's O&M and Capital Improvement Plan (CIP) strategies. Good AM practices will enable Miyahuna to determine the lowest cost options for providing the highest LOS over time. In the area of O&M and CIP, this translates into asset management options and strategies considering all relevant economic and physical consequences, from initial planning, design, procurement, and through final disposal. There are five options for dealing with the critical assets over time:
 - a. Operating and maintaining existing assets;
 - b. Repairing the existing assets/components before they fail, (Predictive Maintenance (PdM));
 - c. Repairing the assets after they fail (Run to Failure);
 - d. Rehabilitating the assets;

- e. Replacing the assets.

Working through sound maintenance strategies requires Miyahuna to move from reactive to proactive maintenance, and understand all associated costs and benefits of repair/rehabilitation vs. replacement.

CIP strategies require investigation of when assets have reached the end of their economic usefulness and require rehabilitation or replacement, and the replacement costs associated with the same. For appropriate decision-making, it is essential to understand lifecycle costs for critical assets and base decisions on asset conditions relevant to their useful economic lifecycle.

5. Identifying short and long-term funding strategies for Miyahuna. Identifying the full economic cost of the services provided is crucial for making sound financial decisions and also for developing an effective long-term funding strategy. Monies are earmarked and spent in two areas; 1) capital assets and overall infrastructure requirement, and 2) O&M expenditures. In a nutshell, the sources of funds to be considered in a utility for the above listed items revolve around four main sources:
 - a. Utility revenues from fees and tariffs;
 - b. Reserve funds from budget surplus or capital fund reserves... etc.;
 - c. Government grants or subsidies;
 - d. Private sector money in the form of loans or partnership shares.

Building an understanding of the five core components of asset management is the first step in Miyahuna's AM program. To establish the AM program Miyahuna has put in place the AMC and they in turn have appointed technical staff to groups to work with ISSP. Data gathering exercises have been undertaken, led by ISSP and supported by Miyahuna staff in order to populate the financial elements of the plan, and to formulate Key Performance Indicators (KPIs) and metrics for the action plans. These exercises provide the foundation of the lifecycle decision-making logic, which is gradually being structured through CUPSS as is described in detail below.

4 THE ASSET MANAGEMENT PLAN

The AMP sets out the approach and methodology to asset management that Miyahuna is and will be implementing in a single document, that discusses each element and how it is handled. In actuality the AMP is a roadmap that describes how Miyahuna is to address each component of asset management. The ultimate goal of the AMP implementation is to:

1. Prioritize asset requirements critical to Miyahuna's performance;
2. Integrate business and financial indicators into the Miyahuna's O&M practices;
3. Assist Miyahuna in becoming a world class low cost service provider;
4. Establish criteria for capital repair, rehabilitation, and replacement decisions based on useful economic life cycles.

The AMP is a practical roadmap that will be utilized at all levels within Miyahuna. It will be further developed to contain concise details of how Miyahuna is to accomplish the goals and objectives outlined in the business plan. The AMP establishes which activities are key, how they will be carried out and sets tangible monitoring criteria for those activities. Not all data crucial to the functional operations will be detailed within the plan, as many separate company components and tools contain those level of details and are designed to manage the same, (e.g., the Geographic Information System (GIS) computer data base, map, the Computerized Maintenance Management System (CMMS), accounting system ... etc.) The indicative data will be in a format that is continually changeable, and should be updated continually as Miyahuna goes about its business and performs its duties. Accordingly, this type of updating will not require the overall plan to be revised. Furthermore, the AMP should be periodically reviewed (e.g. annually or bi-annually) to determine if the overall approach used for each component remains relevant, or if conditions have changed, may necessitate a revision.

As indicated above, Miyahuna, supported by the ISSP team is utilizing the CUPSS software for the development of the company's AMP. The software is already setup for Miyahuna, and the data gathering exercises have been initiated and are underway at the time of writing this report. For this purpose, Miyahuna AMC has formed a working group comprised of representatives from every organizational unit within the company to support in the AMP development process.

The AMP, currently under development, builds around the following outline:

1. Executive Summary
2. Introduction
3. Overview of Miyahuna
4. Level of Service
5. Critical Assets
6. O&M Strategy
7. Water and Wastewater Quality
8. Energy Efficiency
9. Capital Improvement Plan
10. Finances
11. Action Plan

The following sections describe in details each heading included in the AMP outline, and specifies for headings 4.0 – 11.0 what each involves; what related best practices are; what the status quo in relation to the specific topic is in Miyahuna; and what needs to be done in that respect to move towards best practices.

ISSP will continue to support Miyahuna in developing its AMP throughout the remainder of the ISSP contract period.

4.1 EXECUTIVE SUMMARY

The executive summary includes a brief description of the Miyahuna and an introduction to the services it provides. It lists Miyahuna's goals and performance objectives (which subsequently translate into LOS agreements deeper within the AMP). The executive summary will also outlines future costs Miyahuna is anticipating, services that are to be improved; how operating costs can be reduced. Enhancements to the budget, financial and long-term funding strategy processes are summarized in this section.

The other portion of the executive summary includes the top five most important concerns in Miyahuna's action plan. This list is entered into CUPSS upon finalizing data entry, and will be drawn into the Executive Summary from other areas of the program. Once all modules in CUPSS are completely populated with required information, the executive summary will be complete. Although expected to be substantially complete by end of May 2013, amendments will continue throughout the remainder of year.

4.2 INTRODUCTION

This section introduces the plan’s purpose and goals, and outlines the major components of the plan. It also includes Miyahuna’s vision, mission and values. And in relation to the subject of the plan, it introduces the AMC and working groups, their roles and responsibilities vis-à-vis developing and implementing the AMP, in addition to any other stakeholders that Miyahuna decides to involve in developing its AMP.

Within CUPSS, Miyahuna staff and the ISSP team is working diligently on completing the data inputs and requisite information found within the respective section of Miyahuna’s Business Plan.

4.2.1 INTRODUCTION

This AMP is for Miyahuna, and describes how it will manage the infrastructure assets. Customer service demands and regulations required Miyahuna to actively manage drinking water and wastewater assets through careful maintenance, repair and replacement decisions. This plan is an effective tool for combining technical, management and financial practices to ensure that the level of service required by the community is provided at the appropriate cost. The plan has the following purposes:

- To demonstrate responsible management of the drinking water and wastewater assets;
- To communicate and justify funding requirements indicated by the plan;
- To provide a management roadmap for Miyahuna; and
- To serve as a link between Miyahuna and its customers.

The AMP contains an overview of Miyahuna, its mission statement, LOS agreements, critical asset list, its O&M strategy, its CIP, and financial strategies.

4.2.2 MISSION STATEMENT

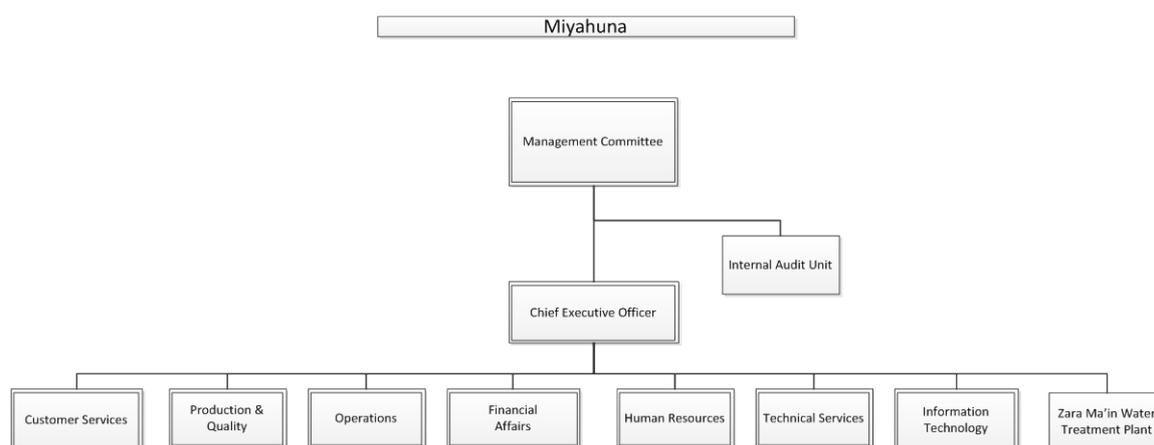
Miyahuna’s mission statement defines its goals, and is the guide for the LOS agreements discussed in the respective section in the AMP. Miyahuna’s mission statement is as follows:

- Vision: “To be recognized for its commitment to the customer and its effectiveness in water and wastewater management”
- Mission: “To enhance the quality of life by providing all its customers with sustainable, efficient and reliable water and wastewater services”
- Values: “Quality, Technical Expertise, Trustworthiness and Social Awareness”

4.2.3 ASSET MANAGEMENT TEAM

Miyahuna is headed by a Chief Executive Officer (CEO) appointed by the Board of Directors. The current CEO is Engineer Munir Oweis. In 2011, the Board of Directors appointed Eng. Oweis to a three year term as CEO. The CEO is supported by seven Directors, who are responsible for the operations of their respective departments. These directors are appointed by the Board. Additionally, the Plant manager of the Zara Ma'in Water treatment Plant reports to the CEO. Miyahuna organization is show in Figure 1-1:

Figure 1-1: Miyahuna Organization (Source: Miyahuna Business Plan 2013 – 2017)



Further details of the roles and responsibilities of each Directorate can be found in the business plan.

Miyahuna has a staff of 1,493 Full time employees (FTEs) to keep the utility functioning properly. Together with them, the following individuals have volunteered as members of the “Asset Management Team as listed in Table 1-1 below:

Table 1-1: Asset Management Working Group

Name	Position
Majed Al Nimri	Customer Service (CS)
Raed Fararjeh	IT
Mohammad Al Qudah	IT
Ayash Talafha	Financial Affairs (FA)
Baha'a Baghdadi	FA
Laith Harfoshi	Human Resources (HR)

Name	Position
Jamal Zein Abedin	Production and Quality (P&Q)
Zaid Kharabsheh	P&Q
Amer Haroon	P&Q
Feda'a Al-Homod	Technical Services (TS)
Dorgham Abd-Alhadi	Zara-Ma'in
Danial Waraq	Operations
Wala' Bani Mustafa	Operations

The AM working group members are the active staff to perform asset management planning and support the plan with Mohammed Zakaria Talafha (Planning), coordinating with the AMC. The working group is responsible for preparing, implementing, and updating this plan.

Other staff such as support staff are not responsible for implementing the plan, but will support the AMP; for example, a training coordinator is involved with this or other projects, the asset management team is responsible for coordinating such involvement in the developing and implementation of the plan.

4.3 OVERVIEW OF MIYAHUNA

This section includes an overview of Miyahuna in terms of types of services provided; the boundaries of the service coverage area; the size of the population served... etc. More specifically, it includes two distinct parts as follows:

1. Information about types of customers served; storage capacity; volume serviced; and asset values. In CUPSS, some information is entered in this section, while others are derived from “My Inventory” module within CUPSS upon availability. For information to be input into the section, it is anticipated that this will be completed by the working group end of June 2013. In terms of the “My Inventory” module, it is anticipated that for rotating assets, this will be completed by end of June 2013, subsequent to the CMMS rollout in Miyahuna. As for fixed assets, this is envisaged to be a long term process that involves transferring fixed assets data already available within Miyahuna to the CUPSS “My Inventory” module through batch uploading from Miyahuna’s GIS database. This is anticipated to be a four to six month exercise, expected to commence beginning of June 2013. This data will need continuous refinement and validation with more and more sophisticated life-cycle and cost data as it is captured over the years.

4.3.1 MIYAHUNA GENERAL OVERVIEW

Miyahuna, incorporated as the Water Company of Jordan (a limited liability company, operated as a financially viable, self-sustaining entity, and managed under modern commercial principles and private sector practices and fully owned by the Water Authority of Jordan (WAJ)), is responsible for the delivery of potable water and wastewater collection to the population in Amman, Jordan. In 2007, Miyahuna signed a 99 year Assignment Agreement with WAJ to operate Zai and Zara Ma'in Water Treatment Plants (WTPs), operate and maintain the water distribution network, operate and maintain the wastewater collection network, and operate several small Wastewater Treatment Plants (WWTPs). WAJ will continue to supply bulk water and wastewater treatment for the majority of the wastewater volumes.

Zai WTP (design capacity: 90 Million Cubic Meters (MCM)/ year) draws water from the King Abdullah Canal (KAC). This plant utilizes conventional treatment processes. The Zai WTP is located in Salt. The second WTP is the Zara Ma'in WTP (design capacity: 48 MCM) and located in the Jordan Valley. This plant utilizes reverse osmosis as its water treatment process.

The distribution network services 98% of Amman 2.6 million residents. The network is comprised of 6,500 km of primary, secondary, and tertiary pipelines. Storage tanks with a total capacity of 446,700 m³ supply and regulate the volume demanded by the end users. Water is delivered for an average of 32 hours per week. In mid-2013, the Disi project implementation company GAMA, is scheduled to begin delivery of water from the Disi aquifer, near Aqaba. This will provide Miyahuna with the water resources which will enable it to provide better services to the residents of Amman.

The wastewater collection system serves 80% of Amman residents and is comprised of 2,500 km of collection pipeline. More than 90% of the wastewater is collected and transported to Al-Samra WWTP located in Zarqa Governorate. This WWTP is operated by WAJ.

A Program Management Unit (PMU) within WAJ is monitoring Miyahuna's performance to ensure the quality of services and efficiency of operations as defined in the Assignment Agreement.

2. Information about Miyahuna’s evolution in terms of future customer growth; anticipated associated expansions or downsizing; and associated CIP and financing strategies. This part also includes an age profile (age and value) for Miyahuna’s assets as entered into “My Inventory” module with CUPSS upon availability. Similar to what is explained above, this requires transferring fixed assets data already available in Miyahuna to the CUPSS “My Inventory” module through batch uploading from Miyahuna’s GIS database. This is anticipated to be a four to six month exercise, expected to commence in June 2013.

4.4 LEVEL OF SERVICE

This section of the plan enables Miyahuna to track its LOS goals (alternatively described as Strategic Objectives/Elements in Miyahuna’s Business Plan (BP)) in order to prioritize and optimize everyday activities. It provides information on the obligations of Miyahuna, as well as future performance goals. This information is vital since it identifies Miyahuna’s goals and when and to what extent those goals are accomplished. Statistics and data are to be input within this section to establish KPIs, the metrics for gauging when and to what extent they are met.

Goals are included in Miyahuna’s BP under the “Strategic Objectives” tables and listed as “Strategic Elements”. These strategic objectives/goals will be delineated under one of four service areas ((i) Health, Safety and Security, (ii) Asset Preservation and Condition, (iii) Conservation, Compliance and Enhancement, (iv) Service Quality and Cost) already identified within CUPSS, and then associated targets as well as status on achievement will be also entered.

The Strategic Elements that will be included in this section will only be a part of all Strategic Elements included in Miyahuna’s BP, as given priority and consequently authorization for implementation by Miyahuna’s upper management within the fiscal budget.

A summary of these strategic elements are listed below in Table 3-1, and additional KPIs and metrics for the same will be inputted for this section from Miyahuna’s AM working groups and business planning groups in June and July 2013.

Table 3-1: Strategic Objectives, Strategic Elements and Associated Responsibilities (Source: Miyahuna Business Plan 2013 – 2017)

STRATEGIC OBJECTIVES	STRATEGIC ELEMENTS	RESPONSIBILITY
1.0 Deliver water on demand to customers	1.1 Deliver water to customers	Ops
	1.2 Reduce physical and commercial NRW to 15%	Ops, TS, CS
	1.3 Provide water connections for all requests	CS, TS
2.0 Provide wastewater collection and treatment services	2.1 Reduce blockages	Ops
	2.2 Reduce illegal inflow (quantity & quality) – customer survey	CS
	2.3 Implement wastewater reuse	Ops, P&Q
	2.4 Construct wastewater network connections and expansion	TS, CS
3.0 Prepare for continuous supply	3.1 Implement improvements to water network system	TS, Ops
	3.2 Implement improvements to wastewater network system	TS, Ops,
	3.3 Replace current meters with appropriate meters	CS
	3.4 Implement customer awareness program for continuous service	Com, CS
4.0 Manage customer relations	4.1 Each customer receives a timely accurate invoice	CS
	4.2 Improve amounts collected	CS
	4.3 Optimize customer satisfaction	Com, All
5.0 Enhance business operations	5.1 Complete GIS system-water delivery	IT, Ops, TS, CS
	5.2 Complete GIS System-Wastewater Collection	IT, Ops, TS, CS
	5.3 Reduce energy usage	P&Q, All
	5.4 Implement supply chain improvements	Fin, All
	5.5 Implement a comprehensive ERP	IT
	5.6 Implement SCADA, Phase 2	Ops
	5.7 Maintain operating costs	Fin
	5.8 Cash available	Fin
	5.9 Purchase Headquarters Building	HR, TS & Fin
	5.10 Construct Zai Warehouse	Fin
6.0 Comply with applicable laws and regulations	6.1 Keep water and wastewater quality within Jordanian standards	P&Q, Ops
	6.2 Review Assignment Agreement annually for potential revisions	All
	6.3 Ensure a safe environment for Miyahuna employees	All
	6.4 Comply with employment laws	HR

4.5 CRITICAL ASSETS

This section of the plan enables Miyahuna to track its critical assets in order to improve O&M practices and enhance long-term planning efforts. It provides a concise overview of the state of each of Miyahuna’s critical assets, including information on the condition of the asset, the asset’s consequence of failure, the risk associated with the asset, and the asset's life cycle and targeted replacement date.

The first part of the section is a narrative description of Miyahuna’s methodology for assessing its critical assets—rotating and fixed, and the criteria based on which criticality is determined. It also describes the asset risk analysis process that is underway for these assets.

For this purpose, some assets are considered more important than others in making sure that customers receive safe drinking water, or making sure that wastewater is treated effectively, or both. Therefore, the asset management team used the CUPSS software to identify and prioritize critical assets and to improve practices used for routine O&M. This process includes reviewing all assets and recording their conditions likelihood of failure; criticality to the utility; consequence of failure; and redundancy (the number of back-up assets to help support each asset). This will ensure that Miyahuna delivers the LOS described in the previous section.

The Miyahuna asset management team is in the process of performing the critical asset assessment. With respect to rotating assets (electro-mechanical), the following criteria were selected to delineate critical assets from ordinary assets: all machine sets of 20 Horse Power (HP) or greater and any and all equipment essential for compliance or safety. This initial screening has been completed. The team is now in the process of performing the asset risk analysis, which takes into account factors mentioned above and presents them as an Asset Risk Matrix found within the “Critical Asset Inventory Summary”.

The second part of the section is a table summarizing all critical assets, ranked using the probability of failure (as a function of condition and redundancy) and the consequence of failure. Data feeding into this table are derived from data that is inputted in the “My Inventory” module within CUPSS. For rotating assets, data will be inputted into the “My Inventory module” upon receipt of batch upload files from the applicable personnel within the asset management working group. This is anticipated to take place by mid-July 2013. As for the fixed assets, initial delineation criteria are currently being developed to segregate critical assets from non-critical assets. Subsequently,

asset risk analysis will be performed between July and August 2013, and presented in the asset risk matrix within the “My Inventory” module in CUPSS.

4.6 O&M STRATEGY

This section describes the methodology used in determining how assets are managed day-to-day, the rationale and features for the maintenance program including any predictive, routine or preventive practices and specific O&M challenges. For the purpose of the AMP, this section is developed separately from the CUPSS module, and will be inputted into the AMP document.

The first section of the O&M strategy lays out the overall plan for rotating assets and fixed assets. It introduces the different O&M strategies (PdM, Preventive Maintenance (PM), Corrective Maintenance (CM), and Deferred Maintenance (DM)) explained in the following subsections.

4.6.1 ROTATING ASSETS

Presently, Miyahuna employs a PM strategy with its rotating assets in the treatment plants, wells and pumping stations. ISSP has procured and is in the process of supervising the installation and roll out of a new CMMS with a PdM module. This PdM module provides for condition-based maintenance management or condition monitoring of critical rotating assets, as an upgrade to the current CMMS that provides only PM functionality and CM documentation. The first step in implementing the new system is identifying the critical rotating assets—defined as all machine sets of 20 HP or greater and/or any equipment essential to compliance or safety. The critical rotating assets have already been identified and inputting to CUPSS should be completed by the end of June 2013. The critical asset lists and historical data regarding the same will be utilized to populate the CMMS from the second week of June through the end of July 2013.

In the meantime, ISSP is supporting Miyahuna in procuring condition monitoring and remote analysis services in order to implement the condition monitoring of critical assets through within the PdM module supplied, which will evaluate condition trends as a requisite for PdM/condition based maintenance. The various PdM analytical services will be funded and procured by Miyahuna, and it is anticipated that the various service contracts will be in place and ready for implementation between end of June and mid of August 2013. Once the various PdM analytical services have been procured and are in place, condition monitoring data/information will be inputted, as provided, into the PdM module of the newly installed CMMS throughout the remainder of 2013 and in the coming years.

The rotating assets O&M strategy will be developed for the purpose of the AMP by the end of Aug 2013.

4.6.2 FIXED ASSETS

O&M management of fixed assets within Miyahuna is largely reactive in nature, and focuses on symptoms rather than the defects themselves, in large part due to limitations in the maintenance management systems and the inability to effectively tackle physical loss Non-revenue Water (NRW) due to Miyahuna's intermittent water delivery. Miyahuna has a GIS system that can store the history of maintenance activities but which is currently not used to its potential in this regard, due to (1) the lack of accuracy within the spatial databases; (2) extremely limited financial and lifecycle data is available in the GIS database for the critical assets; and (3) disaggregated workflow processes between CS, Operations, Finance, Inventory, and IT that lead to failure to capture retrievable historical maintenance data (physical and financial). In order to utilize the GIS as a tool for maintenance decision making, the following activities need to take place:

1. In enhancing the accuracy within the spatial databases, a field survey accuracy program needs to be implemented. This program entails utilizing survey grade accuracy Hand Held Units (HHUs) by field teams who will utilize three HHUs owned by Miyahuna, but which will require transmission antennae and the purchase or procurement of a web-based reference base station (anticipated to be specified and procured by ISSP early /August 2013). Subsequently, the field survey accuracy program should commence and be a continuous exercise within the utility.
2. Replacement cost data will need to be entered into the GIS database by a team inclusive of technical, financial and O&M services, between mid June and early Aug 2013.
3. Workflow processes will need to be re-engineered to reflect full maintenance cycles which tie a problem report; an investigation; a repair/rehabilitate/replace decision; information about the corrective measures taken; and a close-out of the cycle by capturing the maintenance activity's scope, cost, resources, magnitude and exact locations within the GIS' new asset management module. One of the key requirements of the re-engineering process is the utilization of various types of HHUs which contain standard forms related to the data collection, transmission and storage of all aspects of the workflow processes to be shared, as required, throughout the various Directorates involved. This most likely will require integration programming between several of Miyahuna's computer programs and applications to allow for ease of information flow and sharing. Capture of maintenance activity costs will only be possible subsequent to the integration of these workflow processes and applications between the different directorates, which will require on-going technical assistance (TA) efforts for the foreseeable future in tandem with planning for the GIS enhancements.

The imminent arrival of Disi water and subsequent charging of Miyahuna's water distribution network for a greater percentage of time, will allow it to employ more sophisticated techniques for

tracking and reduction of physical loss NRW. The GIS AM module enhancement will allow for appropriate mechanism for tracking NRW activities as mentioned above and commercial loss activities related to the metering program and any illegal connections.

Although portions of the O&M strategy for fixed assets will be included early on in the planning process, the completion of the same cannot take place until the integration, re-engineering and business alignment exercises have been agreed upon and/or implemented. For the purposes of the AMP, the fixed assets O&M strategy section will be completed by the end of ISSP in November 2013.

4.7 QUALITY ASSURANCE

This section outlines what Miyahuna's quality control and monitoring strategies are to be.

Miyahuna is responsible for monitoring the drinking water quality from source to customer. For that it needs to comply with the Jordanian water standard no. 286/2008 that set the limits for chemical, physical, bacteriological and biological water attributes.

Miyahuna is also responsible for monitoring the water quality of effluent from wastewater plants. For that it needs to comply with the Jordanian reclaimed wastewater standard no. 893/2006, as well as the industrial wastewater that is connected to sewer lines according to the instructions for linking on sewage networks.

An action plan is being formulated at this time with the following a brief description of the same:

Summary Description of Plan:

- Ensure the complete compliance of quality of pumped water to consumers with the Jordanian standards by the full implementation of water monitoring program.
- Obtain the accreditation for labs, improve and upgrade lab testing.

The specific activities included in the action plan are as follows:

- Activity 1- Increase the scope of labs work. Activity action is considered both existing and new due to scope of work. (responsibility: Quality Department/P&Q)
- Activity 2- Stabilize and increase the scope of Miyahuna's accreditation for both national & international accreditation. Activity action is considered both existing and new additional requirements. (responsibility: Quality Department/P&Q)
- Activity 3- Implement the monitoring and operational programs as per the approved testing plan. This is ongoing process since a yearly monitoring program exists. (responsibility: Quality Department/P&Q)

- Activity 4- Review and update operational and process work instructions based on risk assessment issues (responsibility: Process Department /P&Q)
- Activity 5- Installation of Ultra Violet (UV) unit for Zai and Russifa treatment plants (responsibility: Process Department /P&Q).

For the purpose of the AMP the Quality Assurance section will be completed by the end of Aug 2013.

4.8 ENERGY EFFICIENCY

This section outlines what Miyahuna's energy efficiency and management programs that are either in place or to be put in place to optimize energy usage for O&M.

Energy efficiency is one of the key concerns within Miyahuna due to the rapidly rising energy tariffs in the excess of JD 44 million/702,979,388 kilo Watt hour (kWh) that Miyahuna spent on electricity in 2012. Miyahuna's business plan identifies a "5% energy reduction over five years" as one of the key strategic objective. All the strategic objectives included in the business plan will be incorporated within the LOS agreement section within the AMP. Energy efficiency will be given special consideration and will be addressed separately in this section of the AMP due to the magnitude of cost associated with energy use, and its impact on Miyahuna's overall service cost. Key objectives—including energy efficiency, were presented to the executive management of Miyahuna at the beginning of April 2013 for ratification. Upon ratification, the strategic element of "1% per year reduction in kWh usage/cubic meters" will form the basis of the energy efficiency program in the AMP, and appropriate KPIs and metrics will be adopted within the same, to manage the energy program along with the appropriate implementation plan/s.

It is anticipated that the Energy Efficiency section in the AMP will be developed by Miyahuna and ISSP staff by the end of Aug 2013. Implementation of the initial energy efficiency program elements is expected to take from six to 12 months, but refinement and addition to the same will continue in earnest for the next two years.

4.9 CAPITAL IMPROVEMENT PLAN

Asset management enables a utility to determine the lowest cost options for providing the highest level of service over time. Utilities need to optimize the work O&M crews are doing, where they are doing it, when and why. The asset management program will help Miyahuna make risk-based decisions by choosing the right project, at the right time, for the right reason.

Tracking high risk assets will help Miyahuna identify and prioritize critical asset maintenance decisions. The CIP section in the AMP provides information that will assist Miyahuna in improving O&M decision-making practices, and enhance its long-term planning efforts. The CUPSS program will populate an “Asset Risk Matrix,” in the “My Inventory” module that will further refine risk level priorities for Miyahuna’s critical assets. The CUPSS risk matrix will automatically be imported into the CIP section in tabular format. The matrix will be utilized along with historical maintenance data on both fixed and rotating assets to formulate financially sound repair/rehabilitate/replace decisions, based on industry standards for useful economic life cycles. The maintenance history for the rotating assets will be imported from the new CMMS at the plants, wells & pump stations and vehicle repair shop. In the future, fixed asset maintenance costs will be imported from an AM module enhancement made to the GIS.

It is anticipated that condition trend monitoring of critical rotating assets will commence using the PdM module in the newly installed CMMS late in the third quarter of 2013, subsequent to the procurement and awarding of a full spectrum vibration remote analysis and tribology/oil analysis contracts. Besides its applicability to maintenance strategy, this program is relevant to CIP in that it will enable Miyahuna to: (i) more accurately assess the lifecycle conditions of major critical rotating assets; and (ii) add to the CIP predictions for not only replacement, but major rehabilitation (capital repairs) of critical rotating assets.

As for fixed assets, condition and maintenance history will be captured in a future AM module enhancement to the GIS, which will provide analytical criteria for repair/rehab/replace decision-making, which relates directly to CIP process. There are prerequisites to adding an AM module to the GIS related to workflow process integration and spatial accuracy. Depending on budgetary and contractual constraints, it is not expected that all of the prerequisites can be completed prior to the end of the first quarter of 2014. While completing the aforementioned prerequisites, technical specifications for the AM module enhancement to the GIS will be developed so that procurement and roll-out of the module is concurrent with the completion of the prerequisites.

Once all asset management planning systems are in place and operational within Miyahuna, the capital improvement requirements will be identified clearly. However, prioritizing them and listing them in a realistic CIP entails close cooperation and planning coordination between Miyahuna and WAJ, due to the existing set-up between the two parties, and the fact that WAJ owns the majority of assets that Miyahuna is operating, and the arrangement that is included in the Assignment Agreement governing the contractual relationship between the two parties in this respect. Also, in addition to the aforementioned institutional constraints, budgetary constraints remain an impediment to the ability of Miyahuna and WAJ to fund their capital replacement and CIP.

For the purpose of the AMP, this section will be substantially completed by the end of Oct 2013, with the possible exception of whatever governmental constraints/policy decisions are to be changed in order to allow for proper state of the art asset repair/rehab/replace capital reserve and CIP planning.

4.10 FINANCES

The Finances section presents Miyahuna's financial condition through financial ratios, and its strategy for future financing. More specifically it addresses expenses, how costs are covered, and financing methods for the CIP.

Initially, the Financial Forecast section will present the financial forecast and the financial projection summary graph from the "My Financial Check-Up Report" in CUPSS. This includes the forecast for revenues, costs—including capital requirements, and surplus/deficit.

The Total Expenditure section will present actual and forecasted expenditures. To that effect, the Expenditure Summary table in the section will list line items for revenues, expenses, and other financial information as entered into the "My Finances" module in CUPSS.

The majority of the financial information is already entered into CUPSS. The remaining items which relate to some indicators, not normally tracked in Miyahuna, and financial issues related to the CIP are anticipated to be completed by mid July 2013.

4.11 ACTION PLAN

As a wrap up to information that is presented in all prior sections, an Action Plan will be developed that will translate all activities in the AMP to actual action items that address specific

issues with identified corrective actions to be taken, complete with assigned priority, level of urgency, associated targets, status, expected completion date as well as target completion date. This section of the AMP will be completed by the end of October 2013.

Although portions of the AMP may not be implemented until subsequent fiscal years, nonetheless, business planning and asset management alignment is taking place along with the formulation of the AMP. As an example, the business planning group is aligning with the AMC to put the actions required for the strategic objectives outlined in Miyahuna's business plan into the AM program for action and metrics.

5 NEXT STEPS

ISSP will continue to support the development of Miyahuna's AMP throughout the remainder of its project term, as well as assist in the implementation and execution of strategic AM/MM program elements. Most plan development activities should be completed in 2013, but AM/MM program implementation activities will continue for several years prior to being considered substantially complete. For planning purposes, all activities related to the AMP development and AM/MM program execution can be grouped into two types: (i) activities that fall within ISSP's project timeline (summarized in Table 4: Plan for AMP Development Activities); and (ii) activities that are beyond ISSP's project timeline but are essential to the success of Asset Management at Miyahuna (summarized in Table 5: AM/MM Activities Planned for Miyahuna beyond ISSP).

Table 4: Plan for AMP Development Activities

Action Item		Responsibility			Approximate Completion Date	Comments
		ISSP team	AMC	Working Groups		
AMP Development						
Executive Summary		√	√	√	End of ISSP	
Introduction		√			Mid Mar 2013	Completed
Overview of Miyahuna	Rotating Assets	√		√	End Jun 2013	
	Fixed Assets	√		√	Beg Sept-Beg Nov 2013	Depends on transferring data from the GIS database
Level of Service		√			Mid Jun-Mid Jul 2013	
Critical Assets	Rotating Assets	√		√	Mid Jul 2013	
	Fixed Assets	√	√	√	End Jul-End Aug 2013	Criteria for fixed assets criticality depend on decisions from the AMC
O&M Strategy	Rotating Assets	√		√	End Aug 2013	
	Fixed Assets	√	√	√	End of ISSP	
Water and Wastewater Quality Assurance		√		√	End Aug 2013	
Energy Efficiency		√		√	End Aug 2013	
CIP	Rotating Assets	√	√	√	End of ISSP	
	Fixed Assets	√		√	End of ISSP	
Finances		√		√	Mid Jul 2013	
Action Plan		√	√	√	End of ISSP	
AM/MM Program Implementation Elements						
Specifications for remote vibration analysis		√			Mid Apr 2013	Completed
Specifications for oil analysis		√			Mid Apr 2013	Completed
Executed contract for remote analysis			√		End Jun-Mid Aug 2013	
Executed contract for oil analysis			√		End Jun-Mid Aug 2013	
Transmission antennae specified & procured		√			Beg Aug 2013	
Initial condition monitoring activities with PdM module		√		√	3 rd quarter 2013	
A web-based reference base station specified & procured			√		Beg Aug 2013	
Recommendations and specifications for GIS enhancements		√			End Jun 2013	
Fixed assets replacement cost data GIS entry				√	Mid Jun-Beg Aug 2013	
Initial energy efficiency program elements implementation		√		√	End Aug 2013	

Table 5: AM/MM Activities Planned for Miyahuna beyond ISSP

Action Item	Responsibility		Timeframe	Comments
	TA Advisor	Miyahuna		
Business Process Re-engineering & functional integration of related applications	√	√	2014-2015	
TA for the implementation and roll-out of AM module GIS enhancement:				
• Ability to perform regression analysis	√	√	Mid 2014	
• Statistical modeling	√	√	Mid 2014 – Mid 2015	
• Work order process management	√	√	Mid 2014 – Mid 2015	
Modify Miyahuna's financial management system to allow for:				
• Activity-based costing	√	√	Mid 2014 – Mid 2016	
• Tracking of process related financial parameters	√	√	Beg 2014 – Mid 2015	
Energy efficiency program:				
• Statistical analysis of existing energy consumption data	√	√	End 2013 – End 2014	
• Condition-based testing & defect elimination for rotating assets	√	√	End 2013 – Mid 2015	
NRW program:				
• Specifying and procuring additional detection equipment—including associated training	√	√	Mid 2014 – End 2015	Contingent on the availability of funds
• Meters replacement program	√	√	End 2013 – End 2015	Contingent on the availability of funds

6 ANNEX A: MIYAHUNA AMM/BEST PRACTICE GAP ANALYSIS REPORT

6.1 INTRODUCTION

The Institutional Support and Strengthening Program (ISSP) is a three year USAID funded program to support and develop the water sector in Jordan. The project has completed an initial assessment of the sector and has made six recommendations to be implemented during the next two and a half years. These are:

- Establish a National Water Council to review and advice on national policy.
- Strengthen the Ministry of Water and Irrigation (MWI) to consolidate and improve water resource planning and management responsibilities.
- Focus the Water Authority of Jordan (WAJ) on bulk water supply development, delivery and waste water treatment services.
- Complete the corporatization of retail water supply utilities.
- Establish an independent water utility regulatory commission, including through support to the Performance and Monitoring Unit (PMU) in MWI to transfer and establish relevant functions and staff upon enactment of relevant laws
- Strengthen water users associations and related functions from the Jordan Valley Authority (JVA) to improve and make irrigation services more efficient and effective.

As a part of the strengthening of the water sector, the ISSP is providing Miyahuna (Jordan Water Company) with financial and technical expertise.

Overview

Miyahuna provides water delivery, wastewater collection, water treatment, wastewater treatment for the residents of Amman. Currently, Miyahuna has a limited asset management strategy. With continuous water service a reality in 2014, for the first time in many years, Miyahuna will need to have a more active and aggressive asset management-maintenance management program.

Miyahuna does not have a company-wide automated asset management application. The Zai and Zara Ma'in Water Treatment Plants utilize an automated Asset Management application for use in the plant. The current asset management software is an outdated version of Data stream's MP3 asset management software. In January, Miyahuna decided to upgrade to their asset management software.

As part of its activities, the ISSP team is assisting Miyahuna in strengthening its asset management/maintenance management program. An Asset Management Specialist is reviewing Miyahuna's AM/MM activities and software to provide recommendations to improve AM/MM activities and propose AM/MM software to better manage this program.

6.1.1 BASIS OF GAP ANALYSIS

As part of ISSP's on-going program of support to Miyahuna, it was agreed with the CEO that potential improvements to Miyahuna's asset management should be investigated and recommendations made. During the ISSP's Team's review, the Team found throughout Miyahuna's organization, from the CEO and Directors down through mid-level management and below, the primary sentiment expressed was *"how and when will we get to the point, where we are controlling the work, rather than the work controlling us?"* This is without a doubt the most prevalent problem commonly found within the water & wastewater utility industry worldwide. The majority of utilities are in a reactive mode of operations & maintenance (O&M) and asset management, or what is commonly referred to as "firefighting," rather than in a proactive / predictive mode, or "fire prevention". To better manage Assets and its related maintenance, ISSP is recommending a proactive Asset Management/Maintenance Management Program.

To assist Miyahuna transition to a utility using proactive asset management, the ISSP Team found it relevant to compare current asset management (AM) and maintenance management (MM) practices within Miyahuna to the water industry's best practices (BP). Current best practice is centered on a reliability based maintenance process related to life cycle cost management of critical fixed and rotational assets, the standard for which is currently found in progressive water utilities within Australia and New Zealand. While these countries are different in character to Jordan, their asset management requirements are the same.

Particular attention was given to several adverse factors prevalent in Jordan, which are:

- scarce and dwindling water sources
- lack of accessibility to capital lending
- high energy costs
- intermittent water distribution
- need to balance utilization of water between agriculture and domestic consumption

These factors, which provide unique challenges to the management and staff of Miyahuna, make the need for Miyahuna to change to an asset management oriented organization even more critical.

It should be noted, that although Miyahuna's present management practices do currently include some aspects of AM/MM best practices, they are for the most part reactive in nature. Miyahuna's practices though, are comparable to the situation in the majority of large utilities throughout the world.

Asset management is implemented through an asset management program and typically includes a written asset management plan that dovetails the organizational business plan. To develop an AM/MM Plan for Miyahuna's consideration, the ISSP Team performed a GAP analysis comparing Miyahuna's asset management activities with international best practices. The ISSP Team used the US Environmental Protection Agency's Asset Management: A Best Practices Guide as a framework for the GAP analysis. This framework is presented in Section 2. Many more detailed presentations and discussions of AM best practices are available in other publications, but only serve to expand on the basic tenets and principals outlined in the guide.

Appendix 1 contains sample Asset Criticality and Condition Ranking Worksheets. These samples can be used by Miyahuna in improving its Asset Management Program. Appendix 2 contains examples of Asset life cycles tables and Repair and Replacement Schedules. These examples are not inclusive and should be used as a guide to develop tables specific to Miyahuna.

6.1.2 ASSET MANAGEMENT

Water and wastewater systems are comprised of assets, some that are buried (underground) assets and those assets that are visible (above ground). These assets are the physical components of the system and include: pipe, valves, tanks, pumps, wells, hydrants, treatment facilities, and any other components that make up the system. These assets, which make up a water and wastewater systems, lose value over time as the systems age and deteriorate. As these systems deteriorate, it becomes more difficult to deliver the level of service that the utility's customers expect. In addition, operation and maintenance costs will increase as the assets age and the utility will subsequently be faced with increased costs that may prove excessive with respect to their remaining useful lifecycle.

The first goal of asset management is to provide a required level of service in the most cost-effective way through the creation, acquisition, operation, maintenance, rehabilitation, and disposal of capital assets. A public water and wastewater utility should manage its assets in a cost effective manner because:

- Assets represent a major public or private investment
- Well-run infrastructure is essential to economic development
- Assurance that we can protect Public health and safety
- Water delivery and wastewater collection are essential services
- To preserve natural water resources
- Reduce capital expenditures

A second goal of asset management is to ensure the long-term sustainability of the water and wastewater utility, by helping a utility manager make better decisions on when it is most appropriate to repair, replace, or rehabilitate critical assets. By developing a long-term funding strategy, the utility can ensure its ability to deliver the required level of service in the most cost effective manner.

6.1.3 BENEFITS OF ASSET MANAGEMENT

There are many positive benefits gained from asset management and companies which fully embrace asset management principals may achieve many or all of these benefits. However, Miyahuna may begin to receive some of these benefits simply by starting the process of asset management. These benefits include, but are not limited to, the following:

- Better operational decisions
- Improved emergency response
- Greater ability to plan and pay for future capital repairs and replacements
- Increased knowledge of the location of the assets
- Increased knowledge of which assets are critical to the utility
- More efficient operation
- Better communication with customers
- Rates based on sound operational information
- Increased acceptance of rates
- Capital improvement projects that meet the true needs of the system
- Efficient use of scarce water resources

Miyahuna should strive to achieve as many of these benefits as possible within their asset management program.

6.1.4 ASSET MANAGEMENT AS A BUSINESS PRACTICE

One of the most important aspects of asset management is it should be an integral part of the way Miyahuna does business. Asset management thinking must underlie every activity, every action, and every O&M decision that the utility undertakes. Utilizing asset management to underlie all of Miyahuna's activities means that there must be "buy-in" of the asset management concepts at all levels of the utility from the system operators all the way through to the highest level of management. Every level of employee must be convinced that asset management is important and beneficial to the overall function of the utility. Without sufficient acceptance of asset management, the benefits gained will be greatly reduced and may not succeed at all.

One method to obtain acceptance of asset management is to explain to each employee working within the system the overall goal of the system's asset management strategy and how that particular employee will input into the process. When asset management is adopted as the way of doing business, each employee's input, knowledge, and expertise is important to the process and all are critical to its successful implementation.

Miyahuna's O&M activities must have asset management thinking at their core. For example, when working on the water system to fix a break, the operator should have a map of the system and indicate on it the exact location of the break. The operator should note all pertinent information to the asset management program, such as: location of break, type of break, type of pipe, type of repair, length of time from report of leak to response to scene, length of time to repair the pipe, condition of the pipe in general, materials used, and difficulties encountered.

This information can then be used in many ways, for example:

- Did the same pipe break multiple times?
- Has the system experienced more breaks on one type of pipe than another?
- Did the operator respond in a timely manner?
- Did there pair get fixed in a timely manner?

By tracking this type of data, the utility manager can begin to develop a better understanding of the overall system and its operation. It also ensures that WAJ and Miyahuna, as the asset owners, have documented evidence to base future capital repair and/or replacement expenditure decisions on.

Throughout Miyahuna every employee should consider how their activities impact upon the overall operation of the utility and how their activities fit within the broader structure of the asset management plan. One of the best approaches to receiving buy-in or acceptability of the asset management program at all levels of Miyahuna, is to demonstrate successes using the asset management techniques. There will be many small successes that the program may demonstrate overtime which can be used to convince even the most reluctant employees that these efforts benefit the utility. As an example, producing a map detailing the system's assets in a visual format can be of great benefit to staff, enabling them to carry out their tasks more safely and effectively.

Another example is customer complaints. When the utility receives a customer complaint, it needs to track various items such as:

- What routine maintenance or operational activities were taking place in the time period before the complaint?
- Is there any unusual condition that would cause this type of problem?
- Has this complaint been made before?
- Is there a pattern of complaints of this type (same area, same source, etc.)?
- Has an employee been dispatched to check out this type of complaint?
- How long did it take to respond?

6.2 ASSET MANAGEMENT & BEST PRACTICES

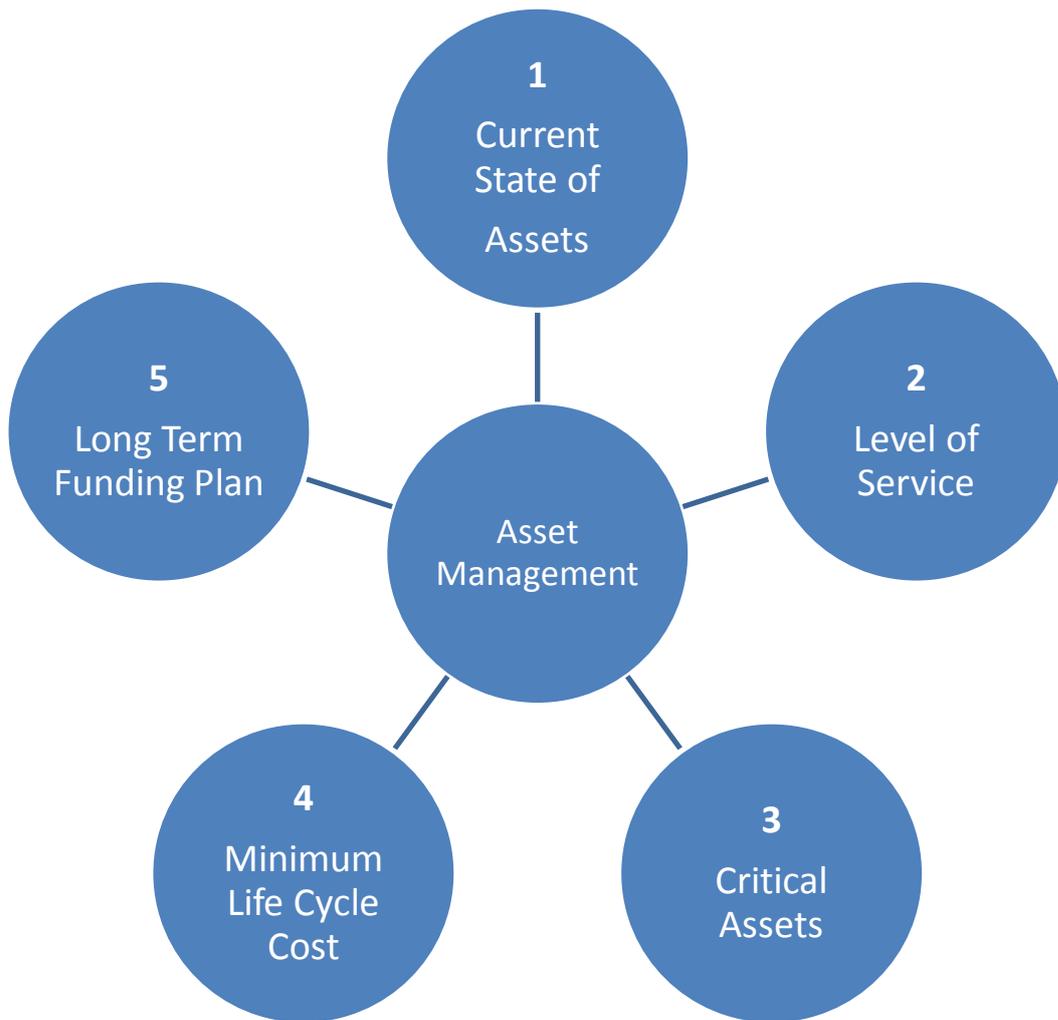
6.2.1 MIYAHUNA GUIDE FOR ASSET MANAGEMENT

Asset management ensures that assets are maintained to the desired level of service that Miyahuna requires its assets to provide, at the lowest life cycle cost. Lowest life cycle cost refers to the best appropriate cost for operating, rehabilitating, repairing, or replacing an asset. Asset management is implemented through an asset management program and includes a written asset management plan.

<i>Issues Facing Miyahuna</i>	<i>Benefits of Asset Management</i>
<ul style="list-style-type: none"> • Determining the best (or optimal) time to rehabilitate/repair/replace aging assets. • Budgeting / accounting for the annualized cost of end of life cycle asset / capital replacement costs to be included in Miyahuna’s management and financial systems. • Expanding service area & rising service expectations of customer base. • Providing accurate figures for the true cost of water, to allow for appropriate tariff decision-making. • Transitioning from a reactive maintenance organization to a reliability centered (RCM) organization. • Less than optimum access to accurate and timely Information between directorates within the organization. • Reducing Non-revenue water resulting from both water loss & commercial issues. • Preparing for onset of continuous water supply 	<ul style="list-style-type: none"> • Prolonging the life cycle of <i>Critical Assets</i>. • Providing accurate performance based data to support the budgetary capital repair / replace decision-making process, through efficient reliability based O&M. • Meeting consumer demands with a focus on system sustainability. • Lowering the cost of Water & Wastewater Services through operating efficiency. • Budgeting activities critical to sustaining level of performance agreements. • Meeting service expectations and regulatory requirements. • Improving response time for emergencies. • Improving quality and quantity of water & wastewater services delivered to the stakeholders. • Conserving scarce water resources

The starting point for a water system asset management program is the core five (5) question framework. This framework refers to all of the major activities associated with asset management. The level of sophistication should be rational with respect to the complexity of the system.

The five core framework questions provide the foundation for Miyahuna’s asset management best practices and some of the key best practices are shown below for each core question.



The flow diagram shows the relationships and dependencies between each core framework question.

Current Condition of Miyahuna's Assets

The first and most critical step in managing Miyahuna's assets, is knowing their current condition. Because some of this information may be difficult to find, Miyahuna can and should use estimates when necessary. Over time, as assets are rehabilitated, repaired, or replaced, the asset inventory will become more accurate.

Miyahuna should ask:

- What assets does Miyahuna own or are responsible for?
- Where is each asset is located?
- What is its condition?
- What is its useful life?
- What is its value? (The replacement cost, in today's Dinars)

Best practices include:

- Preparing an asset inventory and system map (Complete GIS inputs, etc.).
- Developing a condition assessment and condition ranking system to determine which assets are critical assets. (assets essential to provide the level of service set out in Miyahuna's business plan.
- Assessing remaining useful life by consulting projected-useful-life tables and / or decay curves.
- Determining asset values and replacement costs.

Miyahuna's Required "Sustainable" Level of Service

Knowing Miyahuna's required "sustainable" level of service will help Miyahuna management implement an asset management program and communicate to stakeholders what Miyahuna is doing. Quality, quantity, reliability, and environmental standards are elements that define level of service and associated system performance goals, both short- and long-term.

Miyahuna's Business Plan has gathered information about customer demand data from within Miyahuna's Directorates, the Water Authority of Jordan, the assignment agreement from WAJ, and information from stakeholders to develop the level of service (LOS) requirements / Action Plans. Some activities essential to meeting the LOS are on-going and others require actions be initiated by directorates. Actions for meeting essential LOS commitments must be implemented cognizant of critical asset lifecycle's effect on efficiency and cost effectiveness. Actions should updated regularly

to account for changes due to growth, regulatory requirements, technology improvements, and the outcome of asset management lifecycle management history.

Miyahuna should ask:

- What level of service do my stakeholders and customers demand?
- What Level of Service is required from Assignment Agreement provisions
- What do the regulators require?
- What is our actual performance?
- What are the physical capabilities of our assets?

Best practices include:

- Analyzing current and anticipated customer demand and level of satisfaction, with the system.
- Understanding current and anticipated regulatory requirements.
- Writing and communicating to the public a “level of service agreement” that describes Miyahuna’s system-wide performance targets.
- Writing directorate specific level of service agreements, minimizing duplication of efforts.
- Using level of service standards to track system performance over time.

Miyahuna’s Assets are Critical to Sustain Performance

Because assets fail, how Miyahuna manages the consequences of failure is vital. Not every asset presents the same failure risk, or is equally critical to Miyahuna’s water & wastewater system operations. Therefore, it is important to know which assets are required to sustain Miyahuna’s system performance and LOS. Critical assets are those Miyahuna decides have a high risk of failing (old, poor condition, etc.) and major consequences, if they do fail (major expense, system failure, safety concerns, etc.). Miyahuna must decide how critical each asset is and rank them accordingly. Many water systems may have already accomplished this type of analysis through the preparation of failure defense plans.

Miyahuna should ask:

- How do assets fail?
- What are the likelihoods (probabilities) and consequences of asset failure?
- What does it cost to repair the asset?
- What are the other costs (social, environmental, etc.) that are associated with asset failure?

Best practices include:

- Listing assets according to how critical they are to system operations.
- Conducting a failure analysis (root cause analysis, failure mode analysis).
- Determining the probability of failure and listing assets by failure type.
- Analyzing failure risk and consequences.
- Using asset decay curves.
- Reviewing and updating Miyahuna system's failure defense plan (if Miyahuna's system has one).

Minimum Life Cycle Costs

Operations and maintenance (O&M, including Energy), personnel, and the capital budget account for an estimated 85 percent of a typical water system's expenses. Asset management enables a system to determine the lowest cost options for providing the highest level of service over time. Miyahuna, as an efficient utility company, wants to optimize the work O&M crews are doing, and understand where they are doing it, and why. An asset management program helps make risk-based decisions by choosing the right project, at the right time, for the right reasons. Risk based decision-making, simply put, is making decisions based on the outcome's potential effect on LOS and cost effectiveness.

Miyahuna should ask:

- What alternative strategies exist for managing O&M, personnel, and capital budget accounts?
- What strategies are the most feasible for Miyahuna?
- What are the costs of rehabilitation, repair, and replacement for critical assets?

Best practices include:

- Moving from reactive maintenance to predictive maintenance.
- Knowing the costs and benefits of rehabilitation versus replacement.
- Looking at lifecycle costs (includes energy usage), especially for critical assets.
- Deploying resources based on asset conditions.
- Analyzing the causes of asset failure to develop specific response plans.

Miyahuna's Best Long-Term Funding Strategy

The funding for capital assets are split between Miyahuna and WAJ. Miyahuna is responsible for capital improvements up to 5 million JD. WAJ is responsible for all capital improvements above 5 million JD. Sound financial decisions and developing an effective long-term funding strategy are critical to the implementation of an asset management program. Jordan has a policy position where the tariff covers operating expenditures and minor capital improvements. Major capital

expenditures are funded by the Government of Jordan and international donors. Because the responsibility for providing major capital assets and the funding of these assets is not supported by the tariff, Miyahuna needs to establish periodic planning sessions with WAJ counterparts.

Knowing the full economic costs and revenues generated by Miyahuna's water & wastewater systems will enable Miyahuna to determine its system's financial forecast. The system's financial forecast can then help Miyahuna decide what changes need to be made to the long-term system funding strategy and how to justify the same to the Ministry and its donor organizations.

Miyahuna should ask:

- Is there enough funding to maintain our assets for our required Level of Service?
- Which entity is responsible for funding each capital asset?
- How can the coordination with WAJ for planning the acquisition of fixed assets greater than 5 million JD be improved?
- How can the decision process with WAJ be improved?
- Is the rate structure sustainable for the Miyahuna system's long-term needs?

Some strategies to consider:

- Requesting a revision to the tariff structure.
- Funding a dedicated reserve from current revenues (i.e., creating an asset annuity).
- Financing asset rehabilitation, repair, and replacement through borrowing or other financial assistance.

6.2.2 IMPLEMENTING ASSET MANAGEMENT: FOLLOW-UP AND CONTINUING STEPS

The five core questions framework for asset management is the starting point for asset management. Beyond planning, asset management should be implemented to achieve continual improvements through a series of "plan, do, check, act" steps, which are as follows:

- Plan: Five core question framework (short-term), revise asset management plan (long term).
- Do: Implement asset management program.
- Check: Evaluate progress, changing factors and new best practices.
- Act: Take action based on review results.

Modify Miyahuna's Business Plan to reflect the outcome of a more efficient and cost effective organization. The lower cost of water will allow the redirection of savings to enhance future Business Plans.

6.3 ASSET MANAGEMENT GAP ANALYSIS

6.3.1 BEST PRACTICE GAP ANALYSIS CHECKLIST FOR MIYAHUNA

The following table provides Miyahuna with a of activities which need to be accomplished to implement asset management:

Component Of Asset Management	Specific Item	Completed Y or N	Method of Completion	Comments
Asset Inventory	List of Assets	N	Spreadsheet	Not inclusive
	Map of Assets	N	ESRI / GIS	No substantial input since late 2006
	Asset Condition Assessment	N	No ranking system	No ranking of fixed assets some basic estimates on rotating assets
	Remaining Useful Life of the Assets	N	Provided years Of life left	No Life expectancy info provided on inventory
	Asset Value	N	Installed costs only	No replacement costs
Level of Service	Level of Service Agreements	Y	Agreements provided in new business plan	Inclusive of all Directorates & elements
Critical Assets	Criticality Analysis	N	No criticality exercises started	Needs to follow inventory completion

Component Of Asset Management	Specific Item	Completed Y or N	Method of Completion	Comments
Life Cycle Costing	Operation and Maintenance Program	N	Fairly good time based for rotating assets & not much for fixed assets	Fairly thorough basic program but no condition monitoring.
	Repair & replacement Schedule	N	Some based strictly on time passage.	No failure risk analysis
	Capital Improvement Plan(CIP)	Y	5 Year CIP	Needs to include LICAN data & asset decay
Long-Term Funding Strategy	5 Year Financial Plan	Y	Followed Bus Plan Guide	Will be better with LICAN info included
	Tariff Structure	Y	Manually calculated utilizing broad estimates of NRW	Rates do not cover expenses
	Funding Strategy For Repair and Replacement Schedule	N	Utilizes straight line depreciation	R&R schedule does not account for decay curves of assets.
	Funding Strategy For CIP	Y	Table indicating potential funding sources for overall CIP element	Additional AM detail would help justify CIP to Donors

6.3.2 GAP ANALYSIS CONCLUSIONS

Following the gap analysis, the ISSP Team has general observations with respect to the Miyahuna's organization as a whole, followed by a qualitative overview relevant to Miyahuna's present method of doing business, versus an AM centered approach. Subsequently, the challenges related to organizational change management are detailed, with an eye towards the initial steps required to introduce asset management techniques into Miyahuna. Pursuant to the observations and overview, discussion of the gap analysis issues are presented, with ISSP's opinion on what Miyahuna's ensuing steps should focus on, in relationship to the 5 core areas of an effective Asset Management Programs. The proposed focus for Miyahuna is directed towards implementing financially practical and achievable AM / MM procedures, relevant to their business plan and germane to Amman's context within this arid, water resource challenged region.

6.3.2.1 MIYAHUNA OBSERVATIONS & OVERVIEW

Miyahuna now has a very comprehensive and up to date business plan. It far exceeds those which most water & wastewater utilities have in place and in fact, it is on par with industry standards for best practices. A well thought out business plan is absolutely essential to any utility's success, as it is their master plan towards providing value and quality services to the stakeholders. The production and delivery of water and collection of wastewater are actually industrial in nature. The most effective and efficient asset management programs are modeled on industrial operations. Government and municipal organizations have financial and procurement practices in place applicable to the functions they perform, but for the most part do not lend themselves to managing an industrial operation like a water company, etc. Accordingly, after most public sector utilities are formed they don't have the type of asset oriented management tools in place to perform at a Best Practice level of service. This generally leads to the utility becoming reactive in its financial and O&M practices, as budgets and management procedures are not job task resource specific.

One of the primary observations of the gap analysis, points out that organizational change and management training will have to be provided, to all levels of staff within Miyahuna, in order for it to effectively convert to a well-run, asset management oriented, industrial business unit.

It must be recognized by all the stakeholders that moving Miyahuna from a reactive organization to a proactive Asset Managed organization, is a process and as such, will take a substantial effort over several years. Even though the larger implementation may take two or three years, many incremental strides in efficiency and quality can be made along the way within the process.

Even prior to adoption of a companywide Asset Management Program, two organizational / management issues were observed during the evaluation of Miyahuna that were deemed worthy of some immediate action, which are:

- Enhancing the flow of essential corporate information
- Streamlining some of the work flow processes, within the Directorates.

Enhancing the Flow of Essential Corporate Information

First of all, it was observed that the flow of information and supervisory levels of sign off for that information, is being accomplished via an inordinate amount of paperwork and forms and sending them through one division level after another and passing them back and forth between Directorates. The procurement purchase order and receivables documentation process is an example of this type of paper flow. At each level, signatures, copying and potentially redundant data entry, where mistakes are possible, are performed before passing the paper documents on to someone or somewhere else. Purchase requests, receivables forms, inventory control forms, maintenance records, routing, O&M data, financial data, HR data, quality & production data, customer service data, etc. and so on. In most cases, each division / section has developed their own computer spreadsheets to manage these paper oriented processes internally on their own PCs. Both time and money are being wasted and could be easily saved by simply creating some standardized computer forms, with secure digital signature capabilities. The process could be streamlined if those spreadsheets were changed to a standard Microsoft Access D-Base sheet which would also facilitate rapid data entry and directorate specific retrieval within the responsible Directorates.

Streamlining some work flow processes, within the Directorates.

During the review of current maintenance systems, it became clear that considerable skills and competence exists throughout Miyahuna, and with a bit more delegation, these can be harnessed to improve the effectiveness of the organization, particularly as Miyahuna grows in both size and complexity. It was also noted that some directorates have overlapping or closely related responsibilities and consideration should be given to combining some functions. This will become particularly relevant in the management and control of assets particularly with the imminent onset of the management issues related to Disi water.

6.3.2.2 ASSET MANAGEMENT SOFTWARE

Many units within the directorates would like some computer system to be installed that will solve their respective issues and problems. In fact, no program or AM / MM platform will do anything for Miyahuna unless it is fully accepted within the organization and there is change to an effective asset management driven organization. Assets come in three kinds; Fixed Assets (underground pipe, valves, buildings, etc.), Rotating Assets (pumps, blowers, electrical distribution equipment, etc.), and Personnel Assets (the entire Miyahuna staff) and there are AM/MM best practices for each. Accordingly, there are tools and organizational management methods that must be understood and applied for each respectively. During the process of moving from a reactive organization towards a proactive one (asset management based) Miyahuna will be able to make decisions along the way on the most cost effective tools; computer programs, methods of information exchange, AM / MM procedures, and financial management suitable to the desired outcome of each.

In applying “practical” proactive techniques to this companywide effort, ISSP recommends that Miyahuna addresses areas of highest return first to get the biggest return on investment (ROI), in monetary and level of service quality improvements for stakeholders.

With respect to this “low hanging fruit”, Miyahuna should be able to implement AM techniques and methods most easily for its Rotating Assets. The five core framework exercises required to implement asset management are much more readily applied to large above ground physical plant, than that of Fixed (buried) Assets. No significant GIS exercises need be done and condition assessment is relatively straight forward, allowing for minimum life cycle costing, which is easily computerized in the CMMS/PdM software. Digital outputs for SCADA information are already available at the locations where the computers would reside and the additional AM data can be effortlessly integrated with procurement, inventory, and budgetary information to close the lifecycle management loop between the Directorates and the CEO’s designees.

CMMS and Predictive Maintenance

The Production & Quality Directorate’s pumping and treatment activities and the Zara Ma’in WTP and its similar activities, along with Operations Directorate’s Wells & Pumping Stations and Wastewater Departments, appear to be in a position to make use of new CMMS and Predictive Maintenance (PdM) software programs in the near future. Most of the critical assets managed by these Departments are rotating assets, which lend themselves more readily to true AM reliability centered (PdM) maintenance management. Although a good deal of the staff within these departments are fairly well trained in the use of older CMMS systems, they will require change

management training and some technical training related to upgrading to more modern programs that take their older, time based management programs, to condition based (PdM) driven systems. Their AM / MM activities can be integrated most readily (for the least cost and integration complications) with inventory, financial and budgeting data within the Financial Directorate's upgraded ACCPAC software. This should afford Miyahuna an excellent test for implementing PdM AM techniques and incorporating them with the appropriate procurement, financial, and budgetary data integration, required to effect the lowest "Life Cycle Costs" for Miyahuna's critical assets.

There are several very good and reasonably priced CMMS programs, with predictive maintenance modules, that could be implemented in a relatively short time frame at the Zara-Ma'in and Zai Water Treatment Facilities. These facilities could manage the inputs from the remote pumping locations and WWTPs as separate activities within the CMMS systems or additional units can be purchased separately. The implementation of proactive maintenance management at these locations and their integration and debugging efforts with Finance Directorate, should serve Miyahuna well as a road map for the more elaborate aspects of placing the Fixed Assets into a workable program, at least as far as integration efforts are concerned.

GIS

Implementation of asset management best practices for fixed assets is a more complicated than the efforts related to rotating assets. This is due in part to the fact that a large percentage of fixed asset are buried. With fixed assets, producing an accurate inventory, criticality ranking, and determination of lowest life cycle costs is much more involved. The GIS spatial mapping should be updated to include the service population growth in Amman growth that has occurred over recent years. It is reported that limited comprehensive mapping and inventory locations have been added since then, yet the new service areas represent a significant increase in the Miyahuna service area. The GIS system and asset inventory must be updated and populated to include more assets and components of assets, including some life cycle and cost data. This form of mapping information must be substantially complete in order to purchase computerized AM enhancements to the system that will provide some of the management tools for Miyahuna's maintenance activities and decision-making processes. For Miyahuna to manage its fixed assets at the lowest possible life cycle costs, much of the O&M, financial /purchasing, non-revenue water, and inventory data will need to be migrated and shared electronically between many departments. Making sure that data bases are kept current and accurate, is absolutely essential for the AM program to succeed.

Once the fixed asset registry is essentially complete, then criticality ranking can take place, thus filtering the asset registry down significantly to a list of “Critical Fixed Assets”. Again, critical assets are those assets that without them, Miyahuna would not be able to maintain the level of service viability and commitment. Subsequently purchase of appropriate AM / MM computer & GIS enhancements that will streamline the work flow process for O&M Customer Service & Billing, Asset Inventory, purchasing, and W&WW logistics would be possible. Then we need only to follow on to the lessons learned from the divisional / departmental computer integration exercises the managers of the rotating assets went through the previously and Miyahuna should be well on the way to state of the art BP of their assets and work flow.

Personnel Assets

Last but not least, are Miyahuna’s Personnel Assets and employees are critical assets to any organization. Sometimes it is easy to forget, with all the day to day crisis utilities face, that without our employees, no services can be delivered and nothing would be accomplished. The human resources within our organizations often do not get the mentoring, training, and career advancement commensurate with their value to the organizations.

DISI Water

With the advent of full time Disi water supply, Miyahuna’s management will soon face a massive increase in demand on their time, related to systemic problems resulting from that change. Putting emphasis on training and mentoring of subordinate staff to take over more of the routine tasks now, will help alleviate some of the strain management will have with Disi and allow them to concentrate more effectively on finding solutions to the new challenges. In most cases, staff is not only capable of handling more work, but will perform to a very high standard, particularly when given ownership of issues or functions. Lower level staff generally tends to react favorably to additional trust and more complicated work, by gaining a sense of worth, as a member of the team. As long as they are given clear direction and the appropriate level of mentoring / training they should be able to provide much needed assistance during the coming period of change.

Miyahuna will profit greatly from concentrating more of its training resources and effort to lower level personnel for several reasons:

- It will make personnel more efficient and able to handle more complex tasks,
- You can expect better results and output from individuals once you've made the effort to train them in new areas or techniques,
- Lower level personnel have a much lower turnover rate than upper management in general and therefore, are less likely to leave after the organization has spent time and resources on them.

The greater understanding Miyahuna's managers can gain of the interrelationship between the function of each directorate to the overall scheme of things and effectively delegating ownership of work the greater its success as a business unit will be.

Completing the asset registries and criticality ranking exercises for both fixed and rotating assets need to be accomplished, as quickly as possible. It appears completion of the effort for rotating assets is achievable within the next 3 to 4 months. The fixed assets registry and criticality ranking should take an additional 6 to 9 months due to the complexity of the mapping and ranking exercises.

In parallel with completing these efforts Miyahuna should be selecting its IT methodology and requirements and preparing bid specifications for the systems and software that can provide reliability centered maintenance management and lifecycle cost tracking and assistance for rotating assets and finally the same for the fixed assets.

6.4 APPENDIX I - ASSET CRITICALITY & CONDITION RANKING & WORKSHEETS

Asset: _____
Date: _____

Circle the row and column that matches the ranking for both probability and consequence. Where the two intersect becomes your risk.

Multiplied		Consequence(Cost)Of Failure				
		1	2	3	4	5
Probability of Failure	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

1	Very Low
2	Low
3	Moderate
4	High
5	Very High

Risk=Consequence x Probability

Suitability of some Condition Monitoring Systems for a Range of Asset Types

	Vibration	Temperature	Oil Usage/Level/Contaminants	Efficiency Change(Head Loss)	Infrared Thermography, Ground Penetrating	Hours Run	Power Usage Monitoring	Concrete Decomposition Testing and Core	X-ray	Remote Control Television Inspection	Pressure Testing	Smoke Testing	Capacity Modeling (for failure)	Leak Testing	Intelligent Pigs	Protection(Paint)Thickness	Manual Inspection(Operators)	Alarms/Auto Shutdown/Shutdown Telemetry	Life Expectancy Review	Visual Assessments	Laser Profiling/Roughness Meters	Pavement Strength Testers	Skid Resistance Testers	
Dynamic Mechanical Plant																								
Instruments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Control Systems																								
Passive Roads																								
Structures Concrete																								
Earthen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buildings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pipelines Gravity																								
Pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electrical Poles																								
Wires	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Once the assets have been monitored, a condition grading should be implemented and each asset should be rated based on this grading. The utility should determine what type of grading system works best for the specific utility. Below are some examples of grading systems that can be implemented.

Rank	Description of Condition
1	Very Good Condition
2	Minor Defects Only
3	Maintenance Required to Return to Accepted Level of Service
4	Requires Renewal
5	Asset Unserviceable

Intermediate Condition Rating Model

Rank	Description of Condition	
3.0	Level of Service Maintenance	Minor
3.4		Average
3.8		Significant
4.0	Requires Major Upgrade	Minor
4.2		Average
4.4		Medium
4.6		Substantial
4.8		Significant
5.0	Asset Basically Unserviceable	Minor
5.2		Average
5.4		Medium
5.6		Substantial
5.8		Significant

Sophisticated Condition Assessment Model

Base Ranking	Roads (0-100)	Drains Sewers (0-200)	Water Mains (0-500)	Buildings (0-10)	Parks (0-125)	Plan (0-100)
1-	0-200	0-40	0-100	0-2	0-25	0-20
2-	200-400	40-80	100-150	2-4	25-50	20-40
3-	400-600	80-120	150-200	4-6	50-75	40-60
4-	600-800	120-160	200-300	6-8	75-100	60-80
5-	800-000	160-200	300-500	8-10	100-125	80-100

Letter Based Ranking System

Rank	Condition Description
A	Very Good
B	Good
C	Fair
D	Poor
E	Very Poor
F	Failing, needs replacement

Life Remaining Ranking System

Rank	Life Remaining
5	New or nearly new
4	10-20 years
3	5-10 years
2	2-5 years
1	1-2 years
0	0 years

6.5 APPENDIX 2 - ASSET LIFE CYCLE & REPAIR & REPLACEMENT SCHEDULE EXAMPLES

Typical Useful Life for Selected Infrastructure Assets

Sample Useful Live(years)		Sample Useful Live(years)	
Roads:		Wastewater:	
Pavement Substructure	50-100	Gravity Sewer Lines	80-100
Wearing Surfaces	10-20	Manholes	20-50
Curb and Gutter	50-80	Pumping Station Structures	50
Footpaths	15-50	Pumping Station Electrical	15
Bridges	30-80	Risers	25
Culverts	50-80	Treatment Plant Structures	50
Roadside furniture or signage	10	Treatment Plant Electrical	15-25
Bus shelters	20	Parks:	
Bike paths	50	Parks & Gardens	*
Street lighting	20	Fields	*
Traffic Signals	10	Swimming Pools	50
Unsealed roads	-	Plant Nurseries	20
Drainage:		Fountains	50
Drains(underground)	50-80	Cemeteries	*
Culverts	50-80	Public Barbecues	10
Manholes	20-50	Fences	25
Detention Basins	50-100	Play Equipment	25
Pumping Station Structures	50	Buildings:	
Pumping Station Electrical	25	Chambers/offices/halls	50-100

Water Supply		Toilet blocks	50-100
Storage tanks	50-80	Houses	50-100
Treatment Plant Structures	60-70	Sports Clubs	50
Treatment Plant Electrical	15-25	Waste Facilities	
Waterlines	65-95	Landfills	Depends On fill rate
Pumping Station Structures	60-70	Transfer Stations	20
Pumping Station Electrical	25	Garbage collection vehicles	6
		Corporate:	
		Work depots	50
		Vehicles	5
		Office Equipment	5-10
		*Consider each component separately	

Example Repair and Replacement Schedule

Year	Item	Brief	Estimated Cost	Method of Estimation	One Time or Recurring	Time Period of
2007	Meters	Replace/10 of meters	JD 100,000	Knowledge of meter costs from previous	Recurring	Every 10 Years
2008	Meters	Replace 1/10 of meters	JD 100,000	Knowledge of meter costs from previous	Recurring	Every 10 Years
2009	Chlorine Pump	Replace chlorine pump	JD 2,000	Based on previous	Recurring	Every 8 years Based on past experience
2010	Tank 1	Tank Cleaning, Repair, Painting	JD 50,000	Cost for other system similar	Recurring	Every 10 years
2011	Meters	Meters	JD 100,000	Knowledge of meter costs from previous	Recurring	Every 10 Years
2012	Meters	Replace 1/10 of meters w/class	JD 150,000	Priced from estimates from OEM / Suppliers	Recurring	Every 10 Years
2013	Meters	Replace 1/10 of meters w/class	JD 150,000	Priced from estimates from OEM / Suppliers	Recurring	Every 10 Years
2014	Meters	Replace 1/10 of meters w/class	JD 150,000	Priced from estimates from OEM / Suppliers	Recurring	Every 10 Years
2015	Meters	Replace 1/10 of meters w/class	JD 150,000	Priced from estimates from OEM / Suppliers	Recurring	Every 10 Years
2016	Meters	Replace 1/10 of meters w/class	JD 150,000	Priced from estimates from OEM / Suppliers	Recurring	Every 10 Years
2017	Meters	Replace 1/10 of meters w/class	JD 150,000	Priced from estimates from OEM / Suppliers	Recurring	Every 10 Years
2017	Chlorine Pump	Replace chlorine pump	JD 2,000	Based on previous	Recurring	Every 8 years Based on past experience

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